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DIVISION OF ENTOMOLOGY.
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MISCELLANEOUS NOTES

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FOR THE

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WITH ILLUSTRATIONS.

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LETTER OF SUBMITTAL.

DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., June 7, 1886.

SIR: I have the honor to submit for publication Bulletin No. 12 of this Division, which contains certain notes on the work of the Division made during the year 1885, and which were excluded for lack of space from my report of that year. I have also added a paper on *Cicada septendecim*, sent at my request by the author, and containing many interesting original observations, if not always agreeing with those of others.

Respectfully,

C. V. RILEY,
Entomologist.

Hon. NORMAN J. COLMAN,
Commissioner of Agriculture.

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PRODUCTION AND MANUFACTURE OF BUHACH.

By D. W. Coquillett.

Dear Sir: In accordance with your written request for me to prepare a report upon the growth, manufacture, &c., of the insect powder known as "Buhach", as practiced by the Buhach Producing and Manufacturing Company, of Stockton, Cal., I beg leave to submit the following: For much of the information contained herein I am indebted to Mr. G. N. Milco, one of the proprietors of the above firm, and also to the pages of the *Pacific Rural Press*. I obtained much information concerning this new industry while staying at the company's plantation last summer when investigating the locust plague for the Department.

The Buhach Producing and Manufacturing Company's plantation is situated about one mile east of Atwater Station, in Merced County, and contains 800 acres, 300 of which are planted to *Pyrethrum cinerariæfolium*, from the dried flowers of which the above company manufacture the insect powder to which they have given the proprietary name of Buhach.* The soil of this plantation is a sandy loam, so sandy in fact that when the growing upon it of the *Pyrethrum* plants was first attempted many of the plants were buried beneath the loose, drifting sand which was blown about by the winds. To overcome this evil, lines of Lombardy and Carolina poplar trees were planted along the banks of the irrigating ditches to serve as wind-breaks.

The great Merced Irrigating Canal passes through the middle of the Buhach plantation, and the latter is supplied with water from it by a system of irrigating ditches which, if extended in any one direction, would reach to a distance of about thirty miles.

The seeds of the *Pyrethrum* are sown in the spring or fall of the year, and are buried in the soil to the depth of about half an inch by lightly disturbing the soil with a rake. The seed-beds, which are not unlike those used for starting cabbage and tomato plants, are occasionally sprinkled with water. During the rainy winter season the plants are transplanted to the fields, where they are set out in rows four feet apart, and two feet apart in the rows. During the dry summer season the plants are irrigated about once every month.

* The word *Buhach* is derived from the Sclavonic word *Buha*, which signifies a flea; but there is no such word as *Buhach* in the Sclavonic language.

In preparing the ground for irrigation a deep furrow is made between each two rows of the plants by means of a plow drawn by one horse; this plow is so constructed as to throw the dirt to each side of the furrow. After one of the fields has been thus furrowed out, a cross-furrow is made at the ends of these furrows on the highest ground, and the water is turned into this cross-furrow from one of the irrigating ditches. From this furrow the water is in turn let into one of the other furrows, one or two at a time, according to the amount of water supplied by the cross-furrow.

Dams are placed in the irrigating furrows at a distance of about one rod apart, and as soon as the furrow is filled with water to the first dam the latter is removed, and the water flows on to the second dam, and at the proper time this one is also removed; and this process is repeated until all the furrows have been supplied with water.

The next day or so a one-horse cultivator is run once or twice through each of these furrows, for the purpose of filling them up, and also to loosen up the soil to prevent its drying out too rapidly. If the field is weedy the men follow with hoes, and cut out the weeds.

In this manner the plants are treated until the time for gathering the flowers arrives, with the exception that the irrigating is dispensed with during the rainy winter season.

A few of the plants will produce flowers the first year after having been transplanted to the fields, but they produce the most profusely about the third year. The majority of the plants now growing upon the Buhach plantation are six years old, and still bear well. A certain proportion of the plants die every year, and their places are supplied with young plants during the winter season.

The flowers are gathered during the months of May or June. The operator seizes all of the flower-stems growing upon one plant in one of his hands, and with the other cuts them off 3 or 4 inches above the ground by means of a sharp, hooked knife resembling an old-fashioned hand-sickle. They are then conveyed to a wooden stand to which is affixed an iron comb, the teeth of which are wide enough apart to permit the flower-stems to pass between them, but are sufficiently close together to catch the flower-heads. The operator takes a handful of the flower-stems, catching them below all of the flowers, and passes the stems between the teeth of the iron comb, the latter being between his hand and the lowest flower; then giving his hand a jerk the flowers are pulled off of the stems and fall into a wooden box, while the stems are thrown to one side out of the way, to be burned as soon as dry enough.

The flowers are spread out to dry, and at night are covered up to prevent the dew from falling upon them, which would naturally injure their insecticidal qualities. As soon as they have been thoroughly dried they are put into sacks and sent in car-load lots to the mill at Stockton.

Arriving at the mill the flowers are fed to a set of burr mill-stones, just as wheat is handled in making flour by the old process. The grist

is carried by an elevator to a separator which, by proper sieves, separates the coarser particles of the grist, allowing only the finest, dust-like powder to pass through. This powder is carried by an elevator to an adjoining building, where it is put up in tin cans for the market, while the coarser particles thrown off by the separator are returned to the millstones again.

The flowers become considerably heated while being reduced to a powder, but the latter, in passing through a large series of elevators, loses its heat to a great degree before it is put into the cans for the market.

This powder is put up in tin cans of five different sizes, holding respectively 2 ounces, 5 ounces, 10 ounces, 1 pound and 6 pounds. The 2 ounce and 5-ounce cans are packed into boxes containing a dozen cans, and also into cans of 12 dozen cans each; the 10-ounce and 1-pound cans are packed into boxes containing a dozen cans each, and the 6 pound can into boxes holding 6 cans.

Each can of powder bears the company's trade-mark, which is a guarantee of the purity of the powder contained therein. The design of this trade-mark consists of an enlarged figure of a flea above, and a figure of a grasshopper below, while between them are the words: "Buhach: G. N. Milco's California Universal Insect Exterminator," and in the upper corners are the words "Trade-mark." The essential element of this trade-mark is the word Buhach.

Mr. Milco informs me that two years ago a certain firm doing business in this State undertook to put a fictitious article upon the market under the name of Buhach; the Buhach Producing and Manufacturing Company brought a suit against them, but as the said suit has not been decided up to the present writing it is impossible to say what the outcome will be.

Mr. Milco made the first experiment to introduce the growth of the *Pyrethrum cinerariæfolium* into this State in the year 1870. In 1873 he sold a few pounds of the powder, at the rate of $16 per pound. In 1878 he raised about 900 pounds of the powder, which at first he sold at the rate of $4.50 per pound, but finally reduced the price to $1.25 per pound.

In the year 1879 Mr. J. D. Peters united with Mr. Milco in the cultivation of the *Pyrethrum cinerariæfolium* and the manufacture of Buhach, under the firm name of the "Buhach Producing and Manufacturing Company," and for several years they sold the Buhach at the rate of 75 cents per pound, wholesale.

The present price of the Buhach is as follows:

The 6-pound cans are sold to the largest wholesale dealers at from 45 to 50 cents per pound; the wholesale dealers sell them to retail dealers at the rate of 56½ cents per pound, when a case of six cans is purchased at one time, but when less than a case is taken the price is 60 cents per pound. The retail dealers sell these cans to consumers at the rate of 75 cents per pound when the whole can is purchased at one time,

but when only a fractional part of the can is wanted the price is $1 per pound.

The 1-pound cans are sold to wholesale dealers at the rate of $115.20 per gross, less 15 per cent. discount; these are sold to the retail dealers at the rate of $9.60 per dozen, and these dealers sell them to consumers at the rate of $1.25 per can.

The 10-ounce cans are sold to wholesale dealers at the rate of $63 per gross, less 15 per cent. discount; the wholesale dealers sell them to retail dealers at $5.25 per dozen, and the latter charge the consumers 75 cents per can.

The 2-ounce cans are sold to wholesale dealers at the rate of $18 per gross, less 15 per cent discount.; the retail dealers pay $1.50 per dozen for these cans and sell them to consumers at the rate of 25 cents per can.

The company also puts up a small sample box of the Buhach, which is mailed to all applicants free of charge.

The company has two different kinds of instruments for distributing the dry Buhach powder. One of these is called an "insufflator," and somewhat resembles a tin oil-can, such as is commonly used for oiling sewing-machines, but the distributing tube is placed low down on one side, while on the upper side is a tube, open at both ends and projecting into the can; this tube contains a piston which, when pushed downward, throws the Buhach out of the distributing tube in a fine shower, while a spring again pushes the piston upward in its proper place as soon as the pressure from above has been removed. This instrument is held in one hand and the piston is operated by the thumb of the same hand. It is intended for distributing the Buhach in places where only a small quantity of it is required.

It was formerly constructed with an opening in the piston leading into the interior of the insufflator, through which the latter was filled with the Buhach, the opening being afterwards closed with a tight-fitting cork; but an improvement has lately been made by having nearly the whole bottom in the form of a screw-cap, like that on glass fruit-jars, which can be removed by being unscrewed; by this arrangement the insufflator can be filled much easier and quicker than by the old way.

The present price of this insufflator is 25 cents each.

The second instrument, referred to above, is intended for distributing the dry Buhach in large quantities. It consists of a tin can somewhat resembling a common lard-can holding 5 pounds of lard. In the lower part of the can, upon one side, is an opening, into which the nozzle of a small hand-bellows is inserted, while on the opposite side, also near the bottom of the can, is a smaller opening, leading into a spoon-shaped nozzle on the outside. This nozzle is furnished with a slide, so arranged as to regulate the quantity of the buhach that is forced through it by the bellows. The top of the can has an opening 4 inches in diameter,

and is closed by a tightly-fitting screw-cap, similar to that of a glass fruit-jar.

The price of this instrument is $2.50.

For applying the Buhach and water the company has a small pump, which is attached to a galvanized iron vessel holding about 8 gallons. To this pump is attached 10 feet of rubber hose, to the end of which is affixed a small iron tube 5 feet in length, and so constructed that several of them can be fastened together, end to end. To the tip of this is attached a cyclone nozzle, which is screwed on to the end of the iron tube. This nozzle was introduced by the Department of Agriculture a few years ago, and is far superior to any other nozzle that I have ever seen.

The pump consists of a strong brass tube about 2 feet in length, into which is fitted a piston or plunger, which is operated by one hand, while with the other the tube containing the nozzle is moved about at the will of the operator.

The present price of this pump, complete, is $15.

The cost of setting out an acre of *Pyrethrum* plants varies considerably, but should not exceed $90. If the plants are set out in rows 4 feet apart, and 2 feet apart in the rows, it will require about 5,445 plants to the acre. The plants should not cost more than 1 cent apiece, if grown by the person intending to plant them out, and the Buhach Company offers to send a package of the seeds of *Pyrethrum cinerariæfolium* sufficient to plant an acre for the sum of $5.

There will be little or no income from the plants the first year that they are transplanted to the fields. After the second year the plants will yield from 300 to 600 pounds of dried flowers to the acre, but when the winter is dry and cold the plants will not yield more than 150 to 200 pounds of dried flowers per acre the following season.

The kind of *Pyrethrum* now grown upon the Buhach Company's plantation is the *cinerariæfolium*. There are a few plants of the *P. roseum* growing in their nursery, but this species is not considered by them to be so desirable as the former species, although it is hardier and easier to start from the seeds. When a flower of the *cinerariæfolium* is crushed it gives forth a very strong odor peculiar to itself, and doubtless existing in the insect-destroying property of these flowers. The flowers of *P. roseum* give forth no odor when crushed, and the powder made from them is far inferior to that made from the flowers of *cinerariæfolium*, as far as its insecticidal qualities are concerned.

The flowers of all of the *cinerariæfolium* plants appear at the same season of the year, or within a short time of each other, thus permitting the whole field to be harvested at one time, whereas the *roseum* is much more irregular in its flowering, continuing to produce flowers during the greater part of the summer season, sometimes producing a second crop of flowers the same season, but it does not blossom as profusely as the *cinerariæfolium*.

The insect-destroying property of Buhach consists of a volatile oil which, in evaporating, exhales a gas that causes death by asphyxia to those insects which breathe it, producing a similar effect upon insects that chloroform and ether have upon human beings. But, what is very singular, while being so destructive to insect life, Buhach has no injurious effect upon human beings. That such is really the case can easily be proved by a visit to the company's mill at Stockton when in full operation. At such times the air in the room where the flowers are ground into powder is filled with the fine, dust-like particles of the powder; many of the workmen are obliged to remain in this room continuously for several hours at a time, and take no more precautions against breathing the powder than a miller takes against inhaling the fine particles of flour in his mill; and yet they never suffer from the effects of thus inhaling the fine particles of the Buhach powder.

Neither is the Buhach poisonous to either man or animals who eat some of it by chance or otherwise. Mr. Milco writes me that a teaspoonful of the alcoholic extract of Buhach was administered to a certain person afflicted with tape-worm; the dose was repeated every hour for ten consecutive hours, with the effect of removing the tape-worm without in the least degree injuring the patient.

Neither is Buhach poisonous to insects. I have seen locusts feed upon cabbage leaves that had been so thoroughly sprayed with a solution of Buhach and water that the leaves were thickly covered with Buhach after the water had evaporated; still the locusts were not at all injured by thus feeding upon it.

At the stables of the Buhach plantation several tons of the dried stems of the *Pyrethrum cinerariæfolium* were fed to the horses; the latter appeared to relish it very much, and I could not discover that they were injured in the least by thus feeding upon these stems.

It is this perfect immunity from poisonous or other injurious qualities to those using it that has given to Buhach a prominent position among our insecticides, and makes it a perfectly safe remedy to use about the house.

While in one form or another it is so destructive to insect life, still it appears to have little or no effect upon the eggs; it also is not so fatal in its effects upon the pupæ or chrysalids of those insects which pass through a quiet pupa state as it is to the larvæ and to the adult insects. It appears to have the greatest effect upon the higher forms of insect life, while the lower or more or less degraded forms are not so easily affected by it.

Buhach is sometimes applied in a dry state, but for out-door purposes this occasions a great loss, since the finer particles of the powder will float in the air, and be carried away by the wind. A much more satisfactory way of applying it is to mix it in water and spray the insects with the solution.

As the Buhach at first merely paralyzes the insect, it is necessary that this influence upon the latter should continue until death results. To accomplish this some viscid substance should be combined with the solution of Buhach and water, in order to cause the solution to adhere to the insects for a sufficient length of time to deprive the latter of their lives. One of the best known substances of this kind is glucose, a semi-liquid refuse of sugar refineries. This substance combines readily with the Buhach solution, and does not appear to have an injurious effect upon the plants that have been sprayed with it. A low grade of brown sugar would doubtless answer the same purpose, although not in an equal degree, not being so viscid when mixed with water.

Besides using the Buhach in a dry form, and mixing it with water, it is sometimes also mixed with alcohol. in the proportion of 1 pound of Buhach to a quart of alcohol; this should stand in a closed vessel for an hour or so, when it may be diluted with water to any extent required. In regard to this solution Prof. E. W. Hilgard, of the University of California, writes as follows to the *Pacific Rural Press* of May 5, 1883 (p. 413):

"I find that the effect of the Buhach is materially increased in duration when instead of the tea the diluted tincture is used, as was suggested by Professor Riley two years ago. The reason is that the alcohol extracts with the essential oil also a green resin, which prevents the too rapid evaporation of the volatile oil, and makes it stick to the insect.

"A quart of alcohol to a pound of powder is the best proportion, but less alcohol may be used. The alcohol may simply be left on the powder for an hour, and the whole then put into 45 or 50 gallons of water, if to be used through a 'San José nozzle.' But it is far better to let the alcohol percolate through the powder, and thus get a clear tincture, of which aliquot parts may at any time be used through any nozzle whatsoever, after proper dilution with water. Thus it becomes a great convenience, since the insecticide solution is ready at any moment without need of boiling or dissolving, and thus the work may be done just when wanted without any preparation. I find a solution made as above quite strong enough for any ordinary insect, including the hairy caterpillar, which at first seems not to mind it much, but after a while tumbles down and succumbs after vain efforts to crawl away. I have not had an opportunity of trying it upon the Diabrotica or 'spotted lady-bug,' but am told that it also succumbs despite its ability to eat almost anything from tobacco to belladonna and henbane. All the aphids yield to it at once, as does the Red Spider when hatched; but it will not kill eggs."

In using the Buhach out of doors the best effect will be obtained when the weather is still and rather cool. In very hot weather the insecticidal properties of the Buhach evaporate too rapidly, thus rendering its time of action so brief as to permit the insect in many cases to

recover. In windy weather the evaporation is also rapid, and the deadly properties of the Buhach are lost, being blown away from the insect, instead of being kept where the latter is compelled to breathe it.

The following experiments with Buhach were made the past season either by myself or where I was permitted to witness them in person:

Tomato worms—the larvæ of *Macrosila carolina*, Linn.—sprayed with a solution composed of one pound of Buhach stirred in ten gallons of water were killed in a few minutes by it. When first sprayed they manifested their dislike by jerking their heads and the forepart of the body from side to side, at the same time emitting from their mouths a dark greenish, semi-liquid substance, as almost every locust or grasshopper will do when taken in the hand. The jerking gradually increased in violence, until finally the worms let go their hold of the plants and fell to the ground, where they wriggled around for a short time, and finally expired. I am not aware that a single tomato worm treated with the above solution recovered from its effects.

The above solution appeared to have no effects upon a Bordered Squash-bug (*Largus succinctus*).

At about 4 o'clock in the afternoon a Twelve-spotted Diabrotica (*Diabrotica duodecim-punctata* Fabr.) was immersed in a solution composed of one and one-half pounds of Buhach stirred into five gallons of water; it was still alive at 9 o'clock, but was dead when examined the next morning.

A horned beetle (*Notoxus cavicornis* LeC.) was immersed in the same solution and at the same time as the above; it was still alive at 3 o'clock in the afternoon of the next day, but was dead when examined the following morning. It became unable to walk about five minutes after it had been immersed, and it remained in that condition, occasionally moving a leg or foot, until it died. Another specimen was sprinkled with the dry powder, but was not killed thereby; this would seem to indicate that Buhach wetted so as to adhere to the insect is far more effective than in a dry state, even though it is diluted to a considerable extent with water.

A black cricket (*Gryllus* sp.?) sprayed with the above solution in the evening was dead the next morning.

An *Eleodes quadricollis* LeC. that had been rolled in the pure Buhach was still alive eight days later, although it did not appear to be as sprightly as it was before being treated with the powder.

A single application of Buhach, either in a dry state or when mixed with water or with alcohol, will not kill locusts or grasshoppers that have been dusted or sprayed with it. When treated to the powder or to either of the solutions they show signs of its effects in from ten minutes to half an hour. At first the hind legs are affected, and the insects raise them over their backs and kick around for a short time, and finally lose all control of them, crawling about by means of their four anterior legs, and dragging their hind legs aftert hem. After a while

the locusts fall down, roll once upon their sides or backs, jerk their legs occasionally, and gradually become quiet. They remain in this condition for a longer or shorter time, and gradually recover, but sometimes a whole day or a day and a half passes after the application has been made before the locusts have wholly recovered from the effects of it.*

Although the locusts are not killed by a single application of the Buhach in either of the forms mentioned above, still they do not enjoy the same immunity when treated with an alcoholic extract of Buhach; a few drops of this extract was dropped upon an adult locust at 1 o'clock in the afternoon, and early the next morning the locust thus treated was dead. This extract is much stronger than the solution of Buhach and alcohol described above, and costs about $3 a pint. It failed to have a fatal effect upon the locusts when diluted with water to any considerable degree.

For the destruction of locusts and other insects that the Buhach will not kill outright, it may still be used with advantage by spreading blankets upon the ground beneath the tree or shrub infested with these insects, and then dusting the latter with the Buhach, or spraying with one of the solutions; this will have the effect of causing the insects to fall upon the blankets in a perfectly helpless condition, when they can easily be gathered up and be destroyed by burning or otherwise.

In order to give some idea of what success other persons have met with in using Buhach for the purpose of destroying various kinds of injurious insects, I will give a few extracts from communications made by the parties using this insecticide.

The following is extracted from a communication which appeared in the *Pacific Rural Press* of January 6, 1883 (p. 12):

"The Buhach powder was mixed with cold water in the proportion of 1 pound of powder to 50 gallons of water. On the 14th instant I sprayed 10 apple trees, the branches of which were literally covered with the Cucumber-beetle (*Diabrotica vittata*), and the result was that these pests immediately fell to the ground in myriads. The spraying was done with a Merigot pump, and the trees were covered a short time only with a fine mist. Although several gallons were mixed, probably not over one gallon was used. I placed in a small box a number of the beetles that had been touched by the spray, and up to the present time all efforts to resuscitate them have failed. A small number of the insects which were not touched by the spray were placed in a phial, and are still living. The Cucumber-beetle plays havoc with pear blossoms and is otherwise destructive, and judging from the very signal success of my late

*Locusts appear to be endowed with more life than the generality of insects. On one occasion I saw a hind leg of a Differential Locust (*Caloptenus differentialis* Thom.) move after it had been separated from the body for several hours. The femur would draw the tibia toward it, then move it back again; and the last movement of this kind that I saw it make occurred *eight hours* after the leg had been separated from the body.

experiment, I feel confident that I will have very little trouble in stopping its ravages during the fruit season.—Jos. Hales."

The following appeared in the same journnal for October 13, 1883 (p. 306):

"This year, with increased yards and more extensive plans, I had scarcely commenced my work when, to my great annoyance, vermin, and especially those mites which infest the nests of sitting hens, came in forces quite appalling. Old remedies were now again employed, but, as before, found insufficient to match the foe. Half discouraged, I was relating my trials to a neighboring druggist; he advised flea powder, and I purchased of him a bottle of Persian insect powder and at once tested its merits. I found it a partial, but only a partial, relief to the few nests where used. Thinking, however, that in this, though imperfect, remedy I had perhaps a hint, a good suggestion, I at once sent to the producers and manufacturers of Buhach at Stockton, Cal., for a small can of their powder, to test still further that kind of 'death to vermin.' A package (one-fourth of a pound) of Buhach powder was promptly mailed to me, and used as soon as received. To my gratification, it seemed to be just the thing I had long been looking for, yet half despaired of ever finding. The first quarter-pound of this powder 'did the business,' where used in sufficient quantity; but it was not enough to go around. So I secured more—two pounds—and I have tested it thoroughly. It is the thing for poultry. It is a success, especially when used freely and frequently. I have tested its merits in nests, upon chicks and hens, on roosts, in cracks and crevices of coops, &c., and with complete success everywhere, I believe. This Buhach powder is the cleanliest, simplest, most easily applied, and safest remedy for vermin which I have yet found good enough."—*Poultry Grower.*

For further experiments with Buhach, I would refer the reader to the back numbers of the American Naturalist, and also to the several Reports of Prof. C. V. Riley, as entomologist to the Department of Agriculture, contained in the Annual Reports of that Department.

D. W. COQUILLETT.

Prof. C. V. Riley,
Entomologist.

ADDITIONS TO THE THIRD REPORT ON THE CAUSES OF THE DESTRUCTION OF THE EVERGREEN AND OTHER FOREST TREES IN NORTHERN NEW ENGLAND.

By A. S. Packard.

INTRODUCTORY NOTE.

In Dr. Packard's third report, prepared for the Report of the Entomologist, Annual Report of the Department of Agriculture for 1885, was contained certain matter, mainly descriptive, which, though valuable, was considered hardly appropriate for a report which it is desired to make severely plain and practical. This matter was, therefore, pruned from the Annual Report and is published here in the more limited edition of the Bulletin.—(C. V. R.)

THE BLACK-HEADED SPRUCE BUD WORM.

(*Teras variana*, n. sp., Fernald.)

This caterpillar is so commonly met with on the spruce and fir that we have given it the above English name, though there are other species which have green bodies and black heads. We first met with it on the terminal shoots of the Black Spruce on Peaks Island, in Portland Harbor, June 22, 1881, and also at Brunswick and Harpswell on the day following, when it was associated with the caterpillars of the Spruce Bud-worm (*Tortrix fumiferana*). Unlike that species it does not, so far as we have observed, cause any decided alteration in the appearance of the shoots of the tree, not being social or abundant enough to strip the leaves from a single shoot, as in the case of the Spruce Bud-worm, or the Reddish-yellow Spruce Bud-worm (*Steganoptycha ratzeburgiana*) found on the White Spruce last season.

The egg-laying habits are not yet known, as none of the moths on issuing from the chrysalis mated or proceeded to deposit eggs.

The caterpillars usually live near the ends of the shoots, feeding on the new leaves, which begin to grow out early in June; cutting off the tender leaves, they make a passage-way between them and the shoot, which they line with white silk. When disturbed they rapidly crawl out of their silken retreat and let themselves down to the ground by a

silken thread. They are very active in their habits and in confinement in tin boxes will squeeze through the narrow space between the box and the cover, so that only an unusually tightly closed box will confine them. Sometimes, at least in two instances, the caterpillars construct a case of the leaves which they had cut off at the end of a fresh bud.

The caterpillars were very abundant this year in spruce and firs on the shores and islands of Casco Bay, from June 10 until July 20. As full-grown larvæ are abundant during the early part of June, it seems that it hibernates among the shoots of the tree during the winter, and that as in the case of the Spruce Bud-worm (*Tortrix fumiferana*) it hatches in August, or at least late in the summer, and becomes nearly fully grown before cold weather sets in.

The caterpillar when fully grown is of the usual shape of a leaf-roller, deep green, with a dark reddish head and cervical shield; before the last molt the head and prothoracic or cervical shield are black.

From the 14th to the 16th of June the caterpillars change to chrysalides within the slight white cocoon they spin among the bases of the leaves next to the shoot. The moths begin to issue early in August, and continue to appear until the middle of the month. In one case the insect pupated from July 6th to the 10th, the moth issuing on the 19th; hence the pupal period lasts about two weeks. Others which pupated July 14 to 16 appeared three weeks later. None of the insects lingered in the pupa state beyond the 14th of August. The moths are subject to great variation, the details of which are given in the description. In their color they are assimilated to the moss-covered bark of the larger branches of the trees they rest on.

The caterpillars are sometimes preyed upon by ichneumons, two small Ichneumonidæ having been bred from pupæ in confinement. No Chalcid parasites have yet been observed to prey upon this species.

Should the worms attack shade or ornamental firs and spruces, they can be subdued by spraying and striking the branches and shoots so as to dislodge the worms.

DESCRIPTIVE.

Larva before the last molt.—Body pale green, nearly of the color of the fresh leaves, with the head and cervical or prothoracic shield black. Length, 10–11^{mm}.

Full-grown larva.—Body pale pea-green, moderately thick, gradually tapering from the middle to the end of the body. Head of the usual shape, somewhat bilobed, not so wide as the body; dull reddish amber, or greenish-yellow amber-colored in front; partly brownish-black behind and on the sides, the black forming two patches on the vertex. Prothoracic or cervical shield black on a greenish ground; varying to greenish-amber edged behind with blackish; sutures and lateral ridge slightly tinged with yellowish. On the body-segments the piliferous warts green, not distinct; arranged as usual in a trapezoid. Thoracic legs greenish amber-colored, first pair larger and darker than the others; abdominal legs pale green, concolorous with the body. Length, 12–14^{mm}.

Pupa.—Body rather slender, the double rows of dorsal spines as usual, but the spines are smaller and not so sharp as usual. End of the abdomen broad, square, and much flattened vertically, with a small down-curved spine on each side; on the square edge of the tip are from four to six slender, small, curved, stiff bristles. There

are two similar bristles on the under side within the edge of the square tip. Length, 8–9mm.

Moth.—Head white or subochreous; palpi dull gray, with white scales. Thorax either white and black or reddish ochreous with white scales. Fore wings with the basal third either black, gray or snow white; usually dark gray; on the outer edge of the dark portion are two groups of sharply raised scales. Beyond is an irregular white band, the white sometimes obscured by gray scales; this band is very irregular in width, being narrow on the costa, widening towards the middle of the wing; it is indented on the inner side at the second tuft of raised scales; where the band is widest, viz., on the outer edge behind the middle of the wing, is a deep sinus, very distinct in those specimens where the band is white; on each side of the mouth of the sinus is a sharp tuft of raised black scales, and within (one near the costa) are the smaller tufts. In those specimens in which the rest of the wing is whitish there is a large triangular dark spot, with the base resting on the costa; usually, however, the outer third of the wing is dusky or clear gray, with dark specks and clouds, and the triangular patch is obscured. Sometimes when the wing is clear gray the veins on the outer third are hardly clouded with a darker shade of gray. Hind wings and abdomen slate gray. Expanse of wings, 12–15mm.

This is a very variable moth, but the four or five raised tufts are nearly always present. Some striking varieties are here noted:

(*a*) Fore wings gray, with a broad whitish-gray band just before the middle of the wing; the large dark triangular spot not present.

(*b*) The outer third of the wing concolorous with the band, thus leaving a large distinct triangular spot.

(*c*) Fore wings snow white at base, with a snow-white band near the base, in the outer edge of which the sinus is very distinct; the outer third of the wing is either white or blackish.

(*d*) The base of the fore wings clear, deep ochreous, and ochreous streaks on the thorax.

(*e*) The most aberrant form, and which would readily be referred to a distinct species if it had not been reared from the same kind of caterpillar. It has a dark, grayish-white head, and two black bands on the thorax. The fore wings are dark gray, finely lined and mottled with black, but interrupted by a broad, very conspicuous, clear ochreous band extending from the base of the wing to the apex, inclosing the median vein and submedian fold. There is only a single high black tuft on the lower edge of the basal third of the wing. One appeared July 30, and another August 20. Hind wings dark slate gray, with an obscure ochreous slash at the apex.

The following description was prepared by Professor Fernald from five specimens sent him:

Head and palpi ashy gray, the latter a little darker on the outside.

The thorax is dark ashy gray, with a few blackish cross-streaks on the forward part of it, and there is a stout thoracic tuft tipped with reddish brown on the posterior part.

The fore wings are ashy gray, variegated with black and white, with a few yellowish scales intermingled. The basal patch is black, more or less broken with whitish, and has three black tufts of scales on the outer edge—one on the fold, another on the cell, and the third between this last and the costa. An oblique band, white on the costa, but suffused below, starts from the basal third of the costa and crosses the wing outside of the basal patch. The inner margin of this band is slightly angulated, the most prominent angle being on the fold. The outer side of the band gives off a prominent angle on the cell, which ends at a large tuft of black scales near the end of the cell, and there are several other tufts along the outer margin of this band. The surface of the outer part of the wing is of a somewhat leaden blue color, especially when worn, and mottled with black, white, and yellow scales,

but the black is mostly in coarse streaks containing several small tufts. The costa beyond the middle is blackish, with three small white spots at nearly equal distances apart. The fringes of the fore wings, the upper side of the hind wings and abdomen are darker gray with a silky lustre. The under side of the hind wings is lighter, with darker cross-streaks or reticulations, which are much brighter towards the apex. The under side of the fore wings is dark gray, except along the costal border, where the markings of the upper side are dimly reproduced. The legs are brown on the outside, but pale yellowish within and on the end of the joints. This seems to be a very variable species, and at first sight one might think that there were more than one species.

One variety has the top of the head yellowish, and the oblique band and outer part of the wing dull whitish and slightly touched with yellowish. Another variety is quite dark, and has a broad bright ochre yellow band through the middle of the fore wing, from the base to the apex.

A third variety, in very poor condition and bred on white spruce in Ashland, Me., has the head white and the basal part of the fore wings white with only slight traces of the black tufts and markings. Expanse of wings, 14^{mm} (Fernald).

THE FIR TORTRIX.

(*Tortrix packardiana*, n. sp., Fernald.)

This moth was bred from the fir on Peaks Island, Casco Bay, Maine, and sent to Professor Fernald, who regarded it as new and sent us the following description:

Head whitish; palpi and thorax ashy gray; fore wings with a whitish ground color, and marked with black, which is more or less overlaid with pale bluish or whitish scales. The black basal patch has an obtuse angle pointing out on the middle of the wings. An oblique black band broken in the cell crosses the middle of the wing. A black patch rests on the costa before the apex, marked with one or two white costal spots; a similarly colored patch within and above the anal angle, and still another on the outer border inclosing the apex, sends in a square projection towards the end of the cell. All the black markings are overlaid more or less with white scales, and the white portions of the wings are somewhat stained with gray. The fringes are dark smoky brown.

The hind wings and abdomen above are ashy gray. Fringes lighter. Under side of the fore wings ashy gray, with the white costal marks reproduced. Under side of the hind wings whitish, irrorate with gray. Expanse of wings, 16–18^{mm}.

Bred from Fir by Dr. A. S. Packard, for whom I name this species in recognition of his extensive and valuable work on North American insects.

THE RED SPRUCE BUD-WORM.

(*Gelechia obliquistrigella* Chambers.)

[Plate I, Fig. 2.]

Associated with the preceding bud-worm occurred in abundance, both on the terminal shoots of the spruce and fir, a little reddish cylindrical caterpillar, about two-thirds as large as the larva of *Teras variana*, and very active in its habits. It occurred as early as the 10th of June, but it disappeared earlier than the caterpillar of *Teras variana*, and the moths, which were common, flying in spruce at and soon after the middle of July, were not seen after the first week in August.

The caterpillars were beaten from the trees from June 10 to July 17; after that it was impossible to find any of them. The moths began to appear July 16–19, and continued to emerge in the breeding boxes until August 1. The duration of the pupa state is about one week

It is evident that the species is single-brooded and that the caterpillar is hatched in August, and becomes nearly full grown in the early autumn, hibernating when nearly full-fed, since the fully grown caterpillars are abundant by the first week of June. The species has been identified for me by Professor Fernald. It was described from Kentucky by Mr. Chambers, but the larva and food-plant have been hitherto unknown.

When about to pupate it spins a small, thin, delicate cocoon, being a tubular case of silk covered with bits of the scales of the spruce or fir buds. It is placed next to the shoot in the débris made by the larva at the base of the leaves. Length, 6mm; diameter, 2mm.

DESCRIPTIVE.

Larva.—Body cylindrical, of the usual form, reddish brown in color, and about 6–7mm in length.

Pupa.—Body rather thick, of the usual pale mahogany brown color, the antennæ and tips of the wings on the under side reaching to the middle of the fifth abdominal segment. End of the abdomen full and rounded, with about ten unequal, irregularly situated slender bristles, which are slightly curved at the end; besides these there are several fine bristles along the side of the body near the tip. Length, 5mm.

Moth.—Head cream white; antennæ with the basal (second) joint white, beyond ringed with white and black. Palpi white, first and second joint speckled with black, second (longest) joint ochreous at the end; third (last) joint with two black rings of unequal size, the outer the longer; the tip white. Fore wings moderately wide, oblong ovate. Ground color ochreous whitish gray; costal region blackish, base black. A broad oblique band proceeds from the costal edge to the middle of the submedian space, ending in two white spots; there are some whitish scales on the outer edge of the band. Just before the middle of the wing is a broad irregular black band, and beyond it in the submedian space a black spot. A third broad black band crosses the wing, ending on the hind margin and breaking up into three black spots on the hind margin; the band incloses near them two twinned white dots. Near the outer fourth of the wing is a conspicuous white line, sharply bent outwards just behind the middle of the wing; beyond the apex of the angle of the line are several white scales. At the base of the fringe is an oblique line of black scales. The fringe, like the adjoining part of the wing, is of mixed gray ochreous, with black scales. Hind wings rather broad, pointed, pearly slate gray. Legs, including tarsi, banded with black. Expanse of wings, 13mm.

When rubbed the green color of the fore wings becomes paler, and the three oblique black bands are more distinct.

THE EVERGREEN SPAN-WORM.

(*Thera contractata* Packard.)

A very common caterpillar on various evergreen trees, such as the Spruce, White Pine, Hackmatack, and the bush or common Juniper, is a little green one, striped with white, which is so assimilated in color to the glaucous green leaves with their whitish under side as to enable the caterpillar to escape ordinary observation.

During the past summer I have found this caterpillar most frequently on the common Bush Juniper in Maine, but in former years have beaten the chrysalids out of the trees already mentioned.

The caterpillar is found in July, but becomes fully grown from the 1st to the 15th of August. Before transforming, it spins the leaves together with a few coarse silk threads and remains in the tree. Those reared on the Juniper became chrysalids by the 19th or 20th of August, and the moths appeared by the 9th of September, so that the pupa state lasts about three weeks. The moths continue to appear until the middle or last of September. Those found on the Spruce appeared September 15, and a pupa found on the White Pine disclosed the moth September 13. Probably by the middle of September all the moths have appeared. Whether they hibernate and lay their eggs in spring, or whether their eggs are laid in the autumn on the terminal twigs, and the species is alone represented by the eggs, remains to be ascertained.

The moth is easily recognized by the sharp fore wings with the narrow, dark, mesial band, which is black and very narrow on the inner edge, and by the pale zigzag line reappearing beneath, also by the black streak near the apex and a smaller apical black dot. It is closely related to the European *T. juniperata*, which feeds on the common Juniper.

DESCRIPTIVE.

Larva.—Body smooth, cylindrical; head smooth, slightly bilobed, not quite so wide as the body. Head and body green, the color of the upper side of the juniper leaves on which it feeds. A broad pale glaucous white dorsal band, on each side of which is a yellowish-white line, which extends along the sides of the supra-anal plate, but not meeting its fellow at the apex. Anal legs broad and large, green, with two tubercles which are large and rounded conical. Thoracic legs pink. Length, 16^{mm}.

Pupa.—Of the usual family shape; green, with a white lateral stripe from the head to the tip of the abdomen, and another lower down along the abdomen, as well as two parallel dorsal whitish stripes. Abdominal spine larger and longer than usual, flattened vertically, acute, surface corrugated; two stout terminal bristles excurved at the ends, a much smaller pair at base of these and along the sides of the spines two additional pairs. Length, 6^{mm}.

Moth.—Pale ash, base of fore wings with two bent parallel black lines, the outer heavier, and marked with longitudinal stripe on the veinlets. Beyond is a broad pale band slightly bent on the median vein. Still beyond is a median band margined with black, narrowing more than usual on the inner margin of the wing, where the two black margins meet, forming two contiguous black patches; in front the band incloses obscure ashen ringlets. A black discal dot; beyond, an obscure pale patch. A white zigzag marginal line, the sharp scallops inclosing dark dots. Hind wings uniformly pale ash color, crossed by two dusky lines. Expanse of wings, 25^{mm} (one inch).

THE PINE PHEOCYMA.*

(*Pheocyma lunifera* Hübn.)

DESCRIPTIVE.

Larva.—Body long and slender, tapering considerably behind the fourth pair of abdominal legs. Head not so wide as the body, rather deeply bilobed, with a lateral V-shaped white spot. A pair of small prominent tubercles on top of the eighth ab-

* This descriptive matter is additional to the note published on p. 327 of the Annual Report for 1885.

dominal segment, and in place of them on the segments is a pair of more widely divergent short black dashes: on the segment next to the last is a transverse ridge. Anal legs long and slender. General color of the body wood or horn brown, of the shade of old twigs, sometimes reddish or greenish. Head marbled with a set of transverse wavy whitish lines on each side of the median line. Body with a lateral row of black dots; beneath, much paler, glaucous green. Length, 35mm.

The larvæ are very variable; in some the body is reddish with longitudinal bands much more distinct than usual; in some the body is pale pea-green, a little paler than the pine leaves; there is a firm, quite wide medio-dorsal line, and on the sides a wider white line next to the broader very conspicuous pale red spiracular line, which is similar in color to the reddish sheath of the pine leaf. Head reddish, with the characteristic oval white spots on each side. In others (as pitch pine) the body is beautifully marbled with gray and whitish. A V-shaped white spot on the side of the head. On the segment next to the last abdominal are two small inconspicuous warts. A faint, broad, grayish-white dorsal band, broadly interrupted at the sutures of the segments by an irregular transverse umber-brown stripe. A faint lateral broad band, containing on the side of each segment a clear, white point. Length, 42mm.

Pupa.—Of the usual rather slender Catocala shape, covered with a slight whitish bloom. The abdominal tip rather blunt, the surface corrugated with irregular longitudinal furrows above and on the sides; spine small, bearing at the end two very large, long stout bristles curved outwards at the ends, which are blunt; at their base are two pairs of slender bristles. Length, 17mm.

Moth.—Body and wings dark ash-gray and reddish brown; thorax crested, dark reddish brown, with two blackish transverse lines. Patagia with a white stripe behind the middle and white scales at the tip; hinder part of the thorax dusted with white. Fore wings black and reddish brown at base, with interrupted and broken black and white lines. Within the middle of the wing is a broad, slightly sinuous whitish-gray band. A large black mark forming a hollow square, the hollow grayish, at the end of the discal space. Beyond this spot are two nearly parallel black lines, the inner bent inwards at a right angle upon the costa, and sending an angle into the extra-discal space; the line is bent outwards on the 1st median vein, then curving inwards and ending on the hind margin of the wing. The outer line curves outwards on the costa towards the apex, is bent on the 1st median vein, and behind is nearly parallel with the inner line. A fine black scalloped hair-line at the base of the fringe, which is darker on the points of the scallops. Hind wings with a double black curved band beyond the middle, the space within the lines filled in with black towards the hinder edge of the wing. An indistinct broad diffuse shade passes across the wing just within the middle. On the under side of both pairs of wings the discal dots are present, and there is a diffuse dark line common to both wings. Expanse of wings, 36mm.

THE PERIODICAL CICADA IN SOUTHEASTERN INDIANA.

By Amos W. Butler, *Brookville, Ind.*

In presenting what I have to say concerning the Periodical Cicada, I have tried not to follow in the footsteps of others. I have gathered much information that is new to me, and, coupled with this, the fact that these observations were made in a locality where this insect had not been previously studied shall, I trust, assure me your consideration.

From our older inhabitants I learn the Cicada has heretofore appeared in Franklin County in the years 1834, 1851, and 1868. This year I have received reports of its occurrence in the counties of Dearborn, Decatur, Rush, Union, Ripley, Franklin, Fayette, Wayne, and Delaware. The latter, however, is not one of the counties in the southeastern part of the State. In Delaware County my informant reports it as "not abundant"; in Union County it was very common; and, I should think, was as numerous in Dearborn and Ripley Counties. In this county and in Fayette it was at no place as common as was expected. We are entirely without the range of the thirteen-year race.

The regularity of its appearance in certain localities is very interesting. Dr. George Sutton, of Aurora, writes me: "In 1851 the first I saw fully developed was on the 24th of May. In 1868 I first saw them on the 28th of May. This year I discovered them on the 29th of May, although there was evidence that a few had made their appearance a day or so before." Its appearance in Franklin County this year was very irregular. The first representatives appeared in a few localities on May 28, and in such localities Cicadas were rather common two days later. In other places, less than half a mile from those just mentioned, no Cicadas appeared until June 4, and in other neighborhoods they were even later in coming forth.

Many pupæ were turned up by the plow in April and May. When these insects emerge from the ground it is with a rush, and a lively scramble ensues for each elevation near the point of their emergence. Trees, bushes, weeds, poles, stumps, fences—in short, everything upon which they can get above the level of their recent homes is ascended. A friend tells me that his hogs thought so much of the Cicadas as an article of food that they would not return to their accustomed feeding

place. They preferred to remain within the woodland at night, and one morning he found attached to the hair of the animals a number of pupa cases. The Cicadas had clambered upon the backs of the hogs, and there left their outer garments. I have learned of several instances in which hogs discovered the Cicadas before they emerged from the ground, and in some localities they rooted over a considerable amount of ground, to some depth, searching for this new-found food. Farmers gathered the immature insects upon their appearance and fed them to poultry.

In most localities where they had been abundant seventeen years before they appeared this year, but in many instances but few insects represented the vast numbers of their previous maturity. In many places where they were abundant at their last preceding appearance no representatives appeared this year. Many were there which did not emerge from the pupal covering, but from the heat of the morning sun, the attacks of birds and of insects, perished.

May 31 they began making their peculiar noise, and by June 7 the woods resounded with their rattling notes. June 5 they began mating. Five days later most of them appeared to be mated. Ten days after beginning mating they commenced depositing eggs. In this work I have always seen the female with the head higher than any other part of the body. Owing to this fact the eggs appear on some trees to have been deposited from a certain direction, while on others the opposite appears to be the direction whence they came. Upon the oak and apple, trees whose limbs generally grow quite erect, the ovipositor has been inserted from above, or from towards the end of the limb; while upon beech, elm, and other trees, which have a drooping habit, the eggs were deposited from the opposite direction, that toward the base of the limb. The female effects an opening into the wood by means of two small saw-like organs. An excavation is made, consisting of two apartments separated by a thin partition of wood. Into these cavities the ovipositor is inserted; apparently an egg is deposited in each of these chambers at the same time, and each one is lying at the same angle with the partition wall. The eggs are packed very regularly, and under a glass of low power look very much like grains of rice. The openings of these egg-cavities are from five-sixteenths to one-half of an inch in length, and were found three-eighths, and occasionally a few one-half, of an inch apart. Sometimes but two or three punctures were to be seen on a limb, and again the punctured limb would be upwards of a foot in length. A limb of Black Gum (*Nyssa multiflora*, Wang.), showing a line of incisions 18 inches long, proved by actual count to have 48 egg chambers upon it, all in a straight line, and doubtless the work of a single insect. The largest limb found punctured was not over one-half an inch in diameter. Egg-laying was not confined to trees of any particular species, yet there were some kinds of trees apparently more desirable than others.

Beech (*Fagus ferruginea*, Ait.), Maple (*Acer saccharinum*, Wang.), Oak (*Quercus*, several species), Honey Locust (*Gleditschia triacanthos*, L.), Black Gum (*Nyssa multiflora*, Wang.), Thorn (*Cratægus*, several species), Wild Crab-apple (*Pyrus coronaria*, L.), Elm (*Ulmus fulva*, Michx. and *U. americana*, L.), Osage Orange (*Maclura aurantiaca*, Nutt.), Sycamore (*Platanus occidentalis*, L.), and among orchard trees, Apple, Quince, and Peach, were trees upon which the females deposited their eggs in greatest numbers, but, from the fact that all of these trees are not present in equal numbers, they could only be occupied in proportion to their abundance. Cicadas were also found laying upon the Tulip Tree (*Liriodendron tulipifera*, L.), Black Locust (*Robinia pseudacacia*, L.), Sweetbrier (*Rosa rubiginosa*, L.), Red Bud (*Cercis canadensis*, L.), Grape (*Vitus cordifolia*, Michx.), Poison Ivy (*Rhus toxicodendron*, L.), Catalpa (*Catalpa bignonioides*, Walt.), and upon the domesticated species of Plum, Pear, Gooseberry, and Currant. I have found them very rarely ovipositing on Hickory (*Carya*, several species), Ash (*Fraxinus americana*, L.), Linden (*Tilia americana*, L.), Walnut (*Juglans nigra*, L.), and Butternut (*J. cinerea*, L.). No eggs were found upon the Wild Cherry (*Prunus serotina*, Ehr.), or upon the cultivated Cherry.

Twenty-three days after the appearance of the Cicadas a perceptible decrease in numbers was observed. Up to this time the males had greatly outnumbered the females, but the decrease in numbers appears to come from the disappearance of the former, which, being the first to appear, are also the first to leave us. Nine days later but few examples could be found, and these were mostly females. Thirty-nine days after appearing but an occasional Cicada could be found, and their season may be said to be ended. These observations were made in localities where they first appeared, but observations in other places sustain the chronology I have given. At a point 5 miles east of Brookville, on July 15, nine days after they had disappeared from the river valleys, I found Cicadas abundant and very active, indicating that they had not yet reached the wane of their maturity.

The typical species, *Cicada septendecim*, L., and the smaller form, *cassinii*, Fisher, were both found here, but the latter was much the more common. Each form frequents a different locality.

I have never seen a place where the territory of the two kinds could be said to overlap. True it is that an occasional representative of one form may be found within the range of the other, but such cases are rare, and when they do occur are easily distinguished.

There are three different sounds produced by the Cicada. The note of surprise is one which never fails to startle the intruder; it is a shrill screech of varying length. When several insects utter this noise at the same time it is almost deafening to one who is close at hand. Another sound is the peculiar rattling noise made by the insect when flying. This utterance is very monotonous, without inflection, and prolonged to various lengths according to the distance of flight. The sounds just

mentioned were uttered by both forms of the insect found here, and were so nearly alike that that uttered by either species could not be distinguished from similar sounds of its relative. I was somewhat surprised at this. The difference in the size of the insects and therewith in the size of the sound organs and of the controlling muscles should, I thought, indicate a difference in the sound produced. In the third distinct sound, that in which the males display their musical charms to the other sex, I found a difference which, in all the investigations I made, proved constant. The note of the varietal form is uttered without much change of tone and, individually, is quite low compared with that of the other form, but collectively the noise, when the observer is near, sounds like the rushing of a strong wind through trees of dense foliage. I have distinguished this sound at a distance of a quarter of a mile from the place of its origin, and at that distance it sounded like the noise made by a swarm of bees passing through the air close at hand. The sound made by the specific form is so peculiar as to at once attract attention. It is uttered in an uncertain quivering way, gradually rising, then falling and passing away as though ended by the exhaustion of the insect. This sound is well represented thus: Fe-e-e-ro-o-o. My friend, M. J. F. McKee, whose valued assistance I have had in preparing my notes on the Cicada, watched the action of this insect in giving utterance to this sound. He says: "The male Cicada (*C. septendecim*) assumes a position on the upper side of a limb or on the body of a tree, always with the head upward, then it elevates the posterior end of its body, at the same time appearing to inflate the abdomen. With the beginning of the sound the elevated portion of the body descends, the abdomen appears to contract until, when the parts reach their natural position, the notes cease. The insect then remains quiet for a period about equal to the length of the musical effort, when the performance is repeated. A noise may be produced from a freshly-killed male by taking hold of each end of the body with one's fingers, and alternately expanding and contracting the abdomen, similar to the manner in which an accordion is played. The sounds thus produced are not similar to those produced by the insect itself, but in many particulars there is a decided resemblance, and this, I think, demonstrates the manner in which the sounds are produced." Evidently this is done by inflating the hollow abdomen with air, and then forcing the air against the corrugated surface of the insect's drum-like membranes, when, by the vibration of these membranes as permitted by the powerful muscles attached thereto, the noise is produced. I have not been enabled to make as satisfactory an examination of variety *cassinii* when uttering its sounds. They are evidently produced in a similar manner, but the motions occurring are different, a trembling of the posterior parts being all that I have discovered.

Toward the latter part of their lives the Cicadas appear to be affected by a peculiar fungus growth. This is most common to the males, but

females are also affected by it. Dr. E. G. Grahn, a friend whose assistance I value highly, has, at my request, examined the Cicada with a microscope. The result of his examination I give in his own words:

"An examination of many of the Cicadæ reveals the fact that they have lost several of the posterior segments of the abdomen, and that this part of the insect is filled with a mealy-looking substance of a somewhat yellowish color. I subjected this substance to microscopical examination and found it to consist of numberless spherical bodies having the general appearance of spores, and it probably is the *Massospora cicadina* (Peck.), but as I had no description of this fungus I could not be certain of this.

"In Bulletin No. 8 of the United States Department of Agriculture, Division of Entomology, Prof. Charles Riley mentions this fungus, and quotes Mr. R. H. Warder, of Cleves, Ohio, who states that 'It seemed to be a drying up of the contents and membranes of the abdomen,' and that he found it in the males who may have lost the posterior segments of the abdomen during copulation, and alludes to it as a 'dry rot,' which 'might be the result of the broken membranes.'

"He further states that he 'never found a perfect male thus affected,' but finally concludes that 'this is not positive proof.' Whether or not Mr. Warder examined this substance microscopically is not stated, but true it is that in the Cicadæ of this year the microscope and the various straining agents reveal countless spherical organized bodies which could not be formed simply by decomposition or transformed of the 'contents and membranes of the abdomen,' and must therefore be regarded as a growth or multiplication of similar organized bodies having the properties and functions of seeds or spores, which have, in some manner, gained access to the bodies of the Cicadæ. It is true, also, that this fungus is found not only in male Cicadas who have lost the posterior segments of the abdomen, but in perfect males as well, as also in females who are yet in possession of many eggs, and in these specimens the eggs and fungus completely fill up the abdomen. In view of these facts—which are well attested—it seems somewhat strange to find Professor Riley quoting without comment the statements of Mr. Warder. The spherical bodies referred to have a diameter of about $\frac{1}{500}$th of an inch, and have the appearance of being covered on their exterior with small granules, spherical in outline, and about $\frac{1}{5000}$th of an inch in diameter. In their fresh state they were subjected to the action of the iodine solution recommended in Huxley and Martin's 'Practical Biology.' A dark border revealed itself, indicating that the cell wall had taken the stain. Acetic acid rendered them more transparent. Aniline green stained both the cell wall and its contents of a nearly uniform color. Being in doubt whether or not the spherical bodies were single spores, I subjected some rather dry ones to pressure, and the cells thus ruptured emitted large numbers of small spherical bodies, having a diameter of from $\frac{1}{10000}$th to $\frac{1}{5000}$th inch, each large cell hav-

ing the appearance of a ruptured sporangium of the ordinary *Penicillium glauca* or *Mucor mucedo;* hence I concluded that the cells were really sporangia, filled with spores. So far I have discovered no traces of mycelium, upon which these sporangia grow, and am thus led to conclude that they multiply by fission—probably external gemmation—and that after a sporangium is thus produced its contents are again divided by a process of fission into numerous spores. As this process was not really seen to take place, the foregoing remarks respecting it may be taken as being theoretical; yet, while making my observations, and particularly upon the slide treated with aniline green, I noticed a number of transparent nucleated bodies, of various sizes, approaching that of the large spherical cells, some of them exhibiting a slight, others a considerable, bulging out of the cell wall together with the contents of the cell. In some of these, this bulging out had proceeded to a length equal to one-half the diameter of the cell itself, and left one to infer that a new cell was to be produced, and that, too, by a process of fission. Hence, my conclusions as before mentioned. This, together with quite a number of the fully formed spherical bodies, was seen in material taken from a complete, perfect male. It is only proper to state that in this case the contents of the abdomen did not completely fill this cavity, and the material was in rather a semi-liquid state and exhibited also immense numbers of minute spherical and rather long rod-shaped moving bodies which were doubtless bacteria. These latter were also found in other specimens in which the posterior segments were missing and the contents of the abdomen, although of the mealy character, were yet somewhat moist, thus affording conditions for the growth and multiplication of bacteria. Being curious to know what could be discovered in the abdomen of a perfect and active male Cicada, I subjected some of the material to examination with a one-quarter inch objective and a 2-inch ocular and later with a 1-inch ocular. In the field of the microscope were seen numerous flat bands, scattered about over and around each other irregularly. In great numbers were seen also very fine hair-like filaments which could be traced distinctly and were found to belong to the flat bands. These latter were made up of a large number of hair-like filaments arranged alongside of each other, which filaments emanated from each other as fibers from a large thread; each fiber preserving its identity, and not being given off as a branch whose identity is lost in its union with the main trunk. What these hair-like filaments really were, I was unable to make out."

I am satisfied that the greater number of Cicadas which escape a forcible death die from the effects of the fungus previously mentioned.

As much time as possible was devoted to studying the enemies of the Cicada. Not only those species which kill them, but also those species which feed upon the dead insects were noted. Among birds the English sparrow, *Passer domesticus*, Leach, is perhaps its greatest enemy. Within one week from the date of the appearance of the Cicada in

Brookville not one could be found, and I doubt if a single specimen was permitted to deposit its eggs, owing to the persistent warfare waged by this garrulous sparrow. Of native birds the Robin, *Merula migratoria*, Sw. & Rich.; Blackbird, *Quiscalus purpureus æneus*, Ridg.; Cat-bird, *Galeoscoptes carolinensis*, Cab.; Red-headed Woodpecker, *Melanerpes erythrocephalus*, Sw.; Golden-winged Woodpecker, *Colaptes auratus*, Sw.; Towhee Bunting, *Pipilo erythrophthalmus*, Vieill.; and Orchard Oriole, *Icterus spurius*, Bp., were their greatest enemies. Food of every other sort appeared to be neglected in order that they might feast for a limited period upon the easily captured Cicada. Of other birds examined the following contained Cicada remains: Brown Thrasher, *Harporhynchus rufus*, Cab.; Baltimore Oriole, *Icterus galbula*, Coues; Scarlet Tanager, *Pyranga rubra*, Vieill.; Blue-gray Gnatcatcher, *Polioptila cærulea*, Scl.; Worm-eating Warbler, *Helminthotherus vermivorus*, S. & G.; Purple Martin, *Progne subis*, Baird; Wood Pewee. *Contopus virens*, Cab.; Wood Thrush, *Hylocichla mustelina*, Baird; Yellow-throated Vireo, *Lanivireo flavifrons*, Baird; Cardinal Grosbeak, *Cardinalis virginianus*, Bp.; Tufted Titmouse, *Lophophanes bicolor*, Bp.; Carolina Chickadee, *Parus carolinensis*, Aud.; Chipping Sparrow, *Spizella domestica*, Coues; Downy Woodpecker, *Picus villosus*, L.; Great-crested Flycatcher, *Myiarchus crinitus*, Cab.; Indigo bird, *Passerina cyanea*, Gray; Cow bird, *Molothrus ater*, Gray; White-bellied Nuthatch, *Sitta carolinensis*, Gmel.; Yellow-billed Cuckoo, *Coccyzus americanus*, Bp.; Black-billed Cuckoo, *C. erythrophthalmus*, Baird; Gold Finch, *Astragalinus tristis*, Cab.; Crow, *Corvus frugivorus* Bartr., and Cedar bird, *Ampelis cedrorum*, Baird. But two species of all the birds examined showed no evidence of Cicada-eating. These were the Blue Warbler, *Dendroeca cærulea*, Baird, and the Warbling Vireo, *Vireosylva gilva*, Cass. Most birds only eat the softer parts, but some species—the Robin, Brown Thrasher, Towhee Bunting, and a few others—eat also the wings and legs, and even occasionally the head. I found Fox Squirrels, *Sciurus niger ludovicianus*, Allen, eating them, the young showing greater fondness for this food than did their parents. The Ground Squirrel, "Chipmunk," *Tamias striatus*, Baird, was very fond of them. I have seen this mammal climb to the highest limbs of an apple tree seeking Cicadas. When Cicadas fell into our streams many of them became the prey of various species of fish. Our fishermen complained of their inability to get fish to take the hook while they were feeding upon this new food. The remains of these insects were found in Black Bass, *Micropterus salmoides*, Henshall; Blue Cat Fish, *Ichthaelurus punctatus*, Jordan; and White Sucker, *Catostomus teres*, LeS. Rev. D. R. Moore, a valued fellow-worker, found two species of snails, *Mesodon exoleta*, Binn., and *M. elevata*, Say, feeding upon dead Cicadas. This fact was a great surprise to me. But few instances were recorded of Digger Wasps killing these insects. *Stizus grandis*, Say, was the only species observed. Aside from the enemies mentioned above, there were many others to which I could not direct my attention.

In general it may be said beetles, spiders, and other insect enemies prey upon them incessantly, while parasitic flies, scavenger beetles, and ants destroy great numbers of their dead bodies.

Young trees upon the lands of nurserymen attract the Cicada in great numbers. I do not know that any specific remedy was tried; if so, no doubt it failed, as those interested secured laborers who collected all the insects they could and killed them. Here and in our orchards is where the greatest damage was done.

Many peculiar ideas are associated with anything that is mysterious. To the uneducated mind the regular appearance of the Cicada, with which it is incapable of associating any thought of growth or of development through other forms, is a great mystery. Such a person also never thinks of an insect save as a destroyer of that which is necessary for his welfare. It was not infrequent to hear agriculturists of fossilized minds discussing the amount of damage the Cicadas would probably do to growing crops. The expressions of another class of persons showed another train of thought. "Why," say they, "these are the same kind of locusts which troubled Pharaoh in Egypt. The Lord has marked them. Don't you hear them say Pha-a-a-r-o-oh ?"

From the best information I can gather, I think with each septendecimal visit these insects are becoming less numerous. The sites of towns, the immense tracts of cultivated lands, together with artificial ponds and other changes which man is causing, are each year lessening the amount of ground suitable for their adult life. Besides what man is doing to make the country unsuited for their habitation, the insects are preyed upon by many enemies which man has brought within the region of their habitation. Natural enemies, by the removal of certain barriers, are enabled to increase. Others, by reason of changes of environment, are found in greater numbers within certain restricted areas; others, again, by changes of habits, are made more aggressive. All in all, he who can carefully look back over the past half or three-quarters of a century, and intelligently study the great changes which have taken place in both fauna and flora, must conclude that, with but a few more returns, this periodical insect will be represented by few or perhaps no descendants of its now vast numbers.

NOTES OF THE YEAR.

THE COLORADO POTATO BEETLE IN GEORGIA.—In the spring of the present year we received the Colorado Potato Beetle (*Doryphora 10-lineata*) for the first time from the State of Georgia. Under date of May 18 we received from Mr. Woodward Barnwell, of Savannah, a letter accompanied by specimens of the larvæ of this insect. There could be no question as to their identity. Both Mr. Barnwell and Dr. A. Oemler, the president of the Chatham County Agricultural Society and author of "Truck Farming at the South," wrote that they had never before heard of this insect within the limits of the State.

The evidence shows that the *Doryphora* did not reach Savannah by gradual spread, as we have heard of it from no nearer point of late years than eastern Tennessee,* and the chances are that it has been directly imported from the North. Such an importation is a very easy matter, as many of the truck farmers in the vicinity of Savannah buy seed potatoes at the North from time to time. Mr. Barnwell himself got last winter 110 barrels seed potatoes from Aroostook County, Maine. Under these circumstances the beetle has probably often been taken to Savannah before, and the very fact that it has never heretofore developed there in sufficient numbers to be noticed affords the best indication that it is not much to be feared in so warm a climate. Still we advised Mr. Barnwell to be on the safe side, and to destroy it as thoroughly as possible by the use of Paris green.

THE SUGAR-CANE BEETLE INJURING CORN (Plate I, fig. 1).—Six years ago *Ligyrus rugiceps* Lec., injured the sugar-cane crop quite severely in certain portions of Saint Mary's Parish, Louisiana. A note upon this habit was given in the Annual Report of the Department for 1879 (pp. 246–247), and the report for 1880 contained quite an extended article on pages 236–240, the result of observations made by Mr. Howard in the spring of 1881 upon the infested plantations. The same article was embodied in Special Report No. 35 of the Department, published April 28, 1881.

The beetle seems to have done little damage to sugar-cane outside of Saint Mary's Parish along the Bayou Teche, and since the great floods in the spring of 1882, which were especially disastrous in that particular region, we have heard no further complaint of sugar-cane pests.

* Specimens of the beetle and larva were received May 31, 1885, from Mrs. Mary Frist, of Chattanooga, Tenn., who wrote that they were destroying the crop of Irish potatoes in her garden.

The present season, however, we were somewhat surprised to receive the same insect—*Ligyrus rugiceps*—from Mr. H. M. Houston, of Monroe, Union County, North Carolina, accompanied by a letter written June 2, 1885, in which he stated that the insect was new to himself and his neighbors, and that it worked just under the surface of the ground, cutting into young corn with five or six leaves, working in as far as the heart and killing the center blades without injuring the outside ones orwithout cutting the plant down. Fig. 1, Plate I, was drawn from specimens working in sugar-cane, but indicates precisely the method of work in young corn.

Mr. Houston gave no particulars as to the amount of damage being done, and although he was written to for further information we did not hear from him again, and the inference is that the beetles disappeared without doing much damage. It was so well shown in Louisiana that this species is capable of exceptional increase and corresponding injury under favorable circumstances that it is not at all improbable that we have here the beginning of a serious damage to corn in North Carolina.

The life-history of this beetle is not known. The most careful search in the Louisiana sugar fields in 1881 failed to show a trace of the larvæ or pupæ, and it was judged probable that they bred in the surrounding swamps. Until something definite is learned concerning the life-history and larval habits, we can only recommend as a remedy the use of fires and trap-lanterns in the field, as the evidence of 1881 shows that the beetle is strongly attracted to light.

The Corn-root Web-worm an old Pest in Indiana.—Professor Forbes' recent discovery of *Crambus zeellus* in Illinois, and his interesting article upon the species in the Fourteenth Report of the State Entomologist of Illinois (1884), in which he treats it as an entirely new pest (and such it is for all that has been published concerning it), renders the following letter from Mr. B. F. Ferris, of Sunman, Ind., received through our Indiana agent, Mr. Webster, of considerable interest:

"In the *Indiana Farmer*, of this date, I notice a communication from yourself in regard to a 'new corn pest,' and asking for information in regard to them. They are not a new pest to me by any means. My first experience with them was about thirty years ago. I had broken up a field of 17 acres of sod, and planted it on the 1st of May in as fine condition as I ever had a sod. Almost every hill came up, and I would not have paid a very high premium to have been insured 50 bushels of corn to the acre. But the corn was not more than well up before I noticed that the cut-worms, as I thought, were cutting it off. Upon examination, however, I discovered that they were not our common cut-worms, but a small dark-colored worm that enveloped itself in a slight web, just as you have described them, and for want of a name I called them 'web-worms,' and they are known by that name in this neighborhood at this time. As a result, they entirely destroyed my field of corn, with the exception of about an acre or so at each end of the field,

where the ground was a little broken by small hollows. They were very numerous in this vicinity that season, and occasionally there have been a few of them since, but not doing much damage until the present season. In one field of mine, which had been pastural two years before breaking, they have almost entirely taken up 4 or 5 acres, so that I have planted a part of it with white beans, and contemplate sowing the balance with buckwheat.

"I think they are produced by a small, whitish miller, with dirty, brownish stripes upon it, as I have seen a great many of them about the fields. They made their appearance about the time the worms commenced their depredations. I also saw a great many about on the first visitation of the 'web-worms,' and supposed at the time that they were the authors of the mischief." * * * [B. F. FERRIS, *Sunman, Ind., July* 4, 1885.

MONEPHORA BICINCTA DAMAGING BERMUDA GRASS. [Plate I, fig. 6.]—This rather striking-looking bug, belonging to the family Cercopidæ, and easily recognizable from its marked coloration, is widely distributed and by no means rare over the more southern portion of the country, but has never been reported as injuring cultivated plants. This season, however, a large number of specimens were received from Hon. A. P. Butler, Commissioner of Agriculture of the State of South Carolina, dated Columbia, October 20, in which he stated that they appeared in 1884 on the farm of Mr. Speigner, on the Congaree River, near Columbia, and destroyed a small patch of Bermuda grass. This year it again appeared in large numbers on the same farm, and completely ruined a 10-acre field of the same grass. Major Butler examined the field in person, and states that it looked as if a fire had passed over it, while thousands of the bugs were found. This exceptional increase of the insect is of considerable interest. The best remedy will be found in burning over the field in the fall.

A NEW ENEMY TO THE PERSIMMON.—Mr. C. W. Johnson, of Saint Augustine, Fla., wrote us, June 23, concerning the work of an insect which punctured twigs of Persimmon and layed its eggs, from which the larvæ hatched and bored into the heart wood. The specimens were recognized as *Oberea bimaculata*, a beetle which customarily lays its eggs in Raspberry or Blackberry, but which we have also observed to oviposit in Cottonwood. It has never before been recorded as injuring Persimmon. *Oberea schaumii*, a closely related species, we have also observed on Cottonwood, and Mr. Schwarz has found it ovipositing in Sassafras.

THE BLACK SCALE OF CALIFORNIA (*Lecanium oleæ* Bernard).—This destructive scale was treated of in the Annual Report of the Department for 1880, pp. 336–337, but little beyond structural details was given. We have received the past season a few notes concerning it from Mr.

Alfred W. Hinde, of Anaheim, Los Angeles County, California, which we think of sufficient interest to publish:

"This is the most common species of scale insect found in southern California, being especially partial to the orange and olive, on which it thrives and increases very rapidly. It appears to do very little harm to the tree itself, even when allowed to multiply undisturbed to its full capacity. But, owing to the sweet secretion which the scale is constantly exuding, and which drops on the leaves and branches, it is always accompanied by a species of black fungus, which thrives on the sweet secretion combined with moisture. It is this fungus which does the real harm, for it grows on the fruit as well as on the leaves and branches. In the case of olives it renders the fruit unfit for making a fine quality of oil; and with oranges it renders the fruit so unsightly that it does not bring near the price that clean fruit does, unless each orange is thoroughly rubbed with a moist cloth, which is a very tedious process. When the scale is killed the fungus disappears, hence the fight against the scale. It is one of the easiest species to kill; a good kerosene emulsion, if thoroughly applied, is sure death to them, provided it is given at the right time, viz., just after the young have left the shelter of the parent scale. To make a thorough job of it the trees should have two sprayings, at intervals of several weeks, as all the young do not hatch out at the same time. A year ago last September we gave our old seedling orange trees a good spraying with a kerosene emulsion, but owing to our lack of experience in mixing the oil and soap, it was not a thorough emulsion, and hence only killed about 50 per cent. of the scale. The season of 1884 was extremely wet, and I find that the black scale increases much more rapidly in a wet than in a dry season. This wetness, combined with the ineffectual spraying, caused the fungus to greatly increase, and the oranges were extremely dirty, more so than in any previous season that I can remember. The present season (1885) has been the exact reverse of last season, being so dry that we have had less than one inch of rainfall since the first of January last to the present date (November 1). Besides being dry the summer has been very hot; at two periods a few weeks apart in August and September the mercury rose to 107° in the shade. At the first hot spell the heat continued for nearly a week. A few days after this hot week we noticed that all the old scale appeared to be dead on the orange trees. I could hardly believe that the hot weather could do this, so I made further examinations, and then I would have another doubting fit and start out and examine them again, but always with the same result, viz., I would not find more than two or three live oil-scale on the trees. The young ones I did not think to look for, as they were probably not yet hatched, except in a few instances. Then we had the last very hot day, September 23, when a thermometer placed in the sun, four feet from the ground, registered 148°, with a hot, burning

wind all day. This capped the climax for the scale and I have no doubt saved this part of the State many thousands of dollars in the improved condition of the fruit without the expense of spraying. I have just now (November 1) made a thorough examination of our orange and olive trees, and find the following results: On large olive trees, no old scale alive, and 50 per cent. of the young dead; on old seedling orange trees, old scale all dead, and only 10 per cent. of the young alive; on young and medium-sized budded orange trees (4 to 7 feet high) I have been unable to find a single live scale, young or old. Under many of the old, dried-up scale insects I find what appear to be masses of dried eggs, but as my lens is not of sufficient power for me to be certain, I will mail you a sample so you can be sure if this is the case. I should be glad to hear from you on this point. The fruit of both olives and oranges is the cleanest I have ever seen here, being entirely free from old, black fungus. We have not sprayed the trees this year, as it was not necessary."

An examination of the specimens sent showed that all the eggs were empty, and that about one-half of the scales had been parasitized by the common California parasite of the Black Scale, *Tomocera californica* Howard, as was evidenced by the circular holes of exit, too large for any other species.

The Black Scale of California found in South Carolina.—This insect (*Lecanium oleæ* Bernard) is found in California infesting a great variety of trees and is one of the most serious enemies to Orange, Lemon, and other fruit trees in that State. In Europe it is confined to the Olive, and is but occasionally found on other plants. The species has not been definitely recorded in this country from any other locality than California, though Professor Comstock, in his Report as Entomologist to this Department for 1880 (p. 336), mentions a scale received from Fort George, Fla., on Live Oak, Holly, Oleander, and Orange as apparently the same.

Under date of May 29, 1885, Dr. J. H. Mellichamp, of Bluffton, S. C., sent a bark louse from White-flowering Oleander, which he had noticed for the past two or three years, which proved identical with California specimens of this insect. It is impossible to say at present what the probabilities are of the spread of this insect in the Southeastern States. If the insect mentioned by Professor Comstock five years ago was indeed *Lecanium oleæ*, it would then seem as though the chances were against its becoming a serious pest in the East.

Bibio albipennis as an injurious Insect.—The general opinion among entomologists has always been that the White-winged Bibio could not be called an injurious insect, as it normally feeds in the larva state on damp, dead leaves on the ground or upon galls attached to such leaves; in other words, upon decaying vegetation. Our correspondence this year with Mr. C. F. Walters, of Northumberland, Pa., however,

shows that where introduced with manure or compost they may injure certain crops. We quote a portion of his letter:

* * * "I am a trucker, and I find these maggots are becoming more numerous every year. The first that I ever saw was four years ago, when they got into my cold frames and destroyed some of my plants. Since then they have been on a rapid increase; at the same time I never was very much alarmed on account of them until last fall, when I plowed my ground (which I always do in the fall, preparatory for spring) I found them to be very numerous. They inhabit the earth not singly, but in masses. * * * I tried to count a batch of them and found that the number would not end in hundreds, but lead to thousands. When I find them in my cold frames the only remedy I have is to lift all the ground, together with the plants, and cast them out. The area which they occupy is from 10 to 24 inches. They are found very close to the surface, just so that they have a very slight protection. When I plowed my ground in the fall I found them under old cabbage leaves and under anything that would shield them from the light. * * * The only soil that I have as yet found them in is such as has been heavily manured for several years in succession. In fact it seems to me that they breed in the manure; at least I have found them in old manure that I had purchased from parties who had kept it over a year, and consequently it was very fine and seemed to suit them. Cold and freezing seem to have no effect upon them. Just as soon as there is the least thaw, if there are any plants suitable to their taste, they will attack them." * * * [C. F. WALTERS, *Northumberland, Pa., March 23*, 1885.

We advised as a remedy the plentiful sprinkling of the infested earth with a kerosene emulsion, well diluted where plants are liable to be damaged, but strong where used on earth in the spring before plants have been set out.

AN ENEMY TO SILK-WORMS.—The common Spined Soldier-bug (*Podisus spinosus* Dall.) is a well-known predaceous insect, and is often mentioned in treatises on injurious insects as one of the beneficial enemies of the destructive species. It has turned up the present season, however, in the role of a noxious insect itself. Mr. E. J. McAuley, of Oakdale, Ill., who fed his silk-worms on leaves of the Osage Orange, found that certain specimens of the bug, brought in by accident upon the leaves, played havoc among his worms, sucking their juices and destroying them. This naturally suggests that the leaves of both Osage and Mulberry should be carefully examined for predaceous insects before giving them to the worms.

GREAT DAMAGE TO BEANS BY BLISTER BEETLES.—Nuttall's Blister Beetle (*Cantharis nuttalli*, Say), one of the largest and most beautiful species of its family, has often been reported as damaging field crops. In the Annual Report of the Department for 1879 it was recorded as doing damage to beans at Fargo, Dak., and the present season it has

appeared in great numbers and inflicted severe injury on the great seed farm of Northrup, Braslan & Co., of Minneapolis, Minn., at La Moure, Dak. This firm has nine hundred acres in beans alone at La Moure, and the loss which they sustained was quite serious. We advised the use of the old remedy of driving the beetles into windrows of straw which are then burned.

ANTHOMYIA ANGUSTIFRONS A LIGNIVOROUS INSECT.—Late in the summer we received from Mr. John G. Jack, of Chateaugay Basin, Province of Quebec, Canada, specimens of a fly which he described as feeding in the larva state upon planted beans. Somewhat to our surprise the flies proved to belong to *Anthomyia angustifrons*, Meig., a species which we had described both in our Ninth Report on the Insects of Missouri and in the First Report of the United States Entomological Commission, as preying upon the egg pods of the Rocky Mountain Locust. This discrepancy in habit is so marked that we wrote to Mr. Jack for full particulars and quote from his reply:

"In answer to your inquiries about the bean-feeding habit of *Anthomyia calopteni*, I gladly give what notes I possess. I first noticed the larvæ on June 25. We had planted a bushel of Golden Wax beans and a few of some other varieties on or about June 15. They had not come through the soil by the 25th, and on scratching away a little of the earth above the rows, I was surprised to find that, although the beans were well sprouted and some of them were near the surface, yet they had an unhealthy appearance, and on examining the cotyledons and stems, I found them infested with maggots. They were in numbers of from one or two to twenty-five or more in a plant, and the interior of the bean and stalk was so eaten away in many instances that only a very thin wall remained. I collected a large number of the larvæ and kept them until they had produced the flies. The larvæ were collected on June 25, and on the 28th a good number had entered the ground to pupate, and on July 2 all of my specimens had pupated and I could not find a maggot in the field. On July 9 and 10 most of the imagines appeared. One-half of the field in which these larvæ were so abundant had been sown in buckwheat the year before, and the other half had a black currant plantation from which the old bushes had been removed. It was in that part of the field where the currant bushes had been that the Anthomyia larvæ were most destructive. Certainly more than nine-tenths (90 per cent.) of the beans were completely destroyed and never grew sufficiently to reach the ground. On the other half of the field, where the buckwheat had been grown, very few of the beans were affected. They were all covered with a plow, with about three inches of soil. The soil is a sandy loam, and the rows ran north and south through both pieces of land, so that the difference caused by the attack of Anthomyia was very marked. In another field, on July 17, I found occasional beans that had not come through the ground, and in them I found several maggots which I think were of the same species,

but I did not keep them. I think that I have noticed similar larvæ in young growing beans during the past year or two, but they were rare and I gave no attention to them. Occasionally the infested beans grew through the surface and the first leaves expanded, but they soon turned yellow and withered and died."

THE TILE-HORNED PRIONUS IN PRAIRIE LAND.—In our Second Missouri Report we gave several instances of the finding of the larvæ of *Prionus imbricornis* in prairie land some distance from large trees, showing that in all probability they fed on the roots of herbaceous and even annual plants. The past summer another instance of the same thing has come to our notice, and Mr. Samuel W. Glenn, of Huron, Dak., states in a letter dated June 3, accompanying a specimen of this larva, that they were found "in large numbers by Mr. J. B. Coomer, a farmer residing six and a half miles southwest of Huron, in ground which was broken in June, 1883, and not since plowed till to-day. Their average distance from the surface was about seven inches. There are no trees within a radius of twenty miles."

THE CLOVER-SEED MIDGE IN WISCONSIN.—Up to the present season the Clover-seed Midge (*Cecidomyia leguminicola* Lintner) has been found only in New York, Vermont, District of Columbia, Virginia, and one locality in Pennsylvania (Lewisburg, Union County). During the past year, however, we have received specimens of infested heads of red clover from eastern Wisconsin, where it seems to have just been noticed for the first time. The chances are against the theory of recent introduction, however, and that the probabilities are that it has been present in the State for some years, becoming abundant enough to attract attention only this season. Mr. Claus Oesan, of New Holstein, Calumet County, wrote under date of June 26, 1885, that hardly a single blossom was to be seen in any of the Red Clover fields in his vicinity, while Alsike and White Clover blossomed as usual. He noticed this same paucity of bloom in the second crop of the previous year, but the first crop of 1884 was full of fine blossoms.

This insect was treated in the reports of the Entomologist, United States Department of Agriculture, for 1878 and 1879, and the remedy recommended in the latter report is to cut the first crop of the season three weeks earlier than usual, giving the larvæ of the midge no time to mature. This remedy necessitates that the farmer should be familiar with the insect in all stages, and should make careful examinations at short intervals until the proper time for cutting arrives. All volunteer clover should also be mowed, and all of the farmers of a neighborhood should cut at about the same time, as otherwise the remedy will be only partly successful.

Dr. Lintner, in his First Report as State Entomologist of New York (p. 54), says:

> In the many instances in which our economic entomologists have recommended plowing under the infested crop, I would venture to supplement this direction: fol

low with a liberal application of fresh gas-lime, if it can be conveniently obtained of perhaps a hundred bushels to the acre. I believe that this would prove the best possible method of arresting severe attacks of the two great clover pests, the clover-seed midge (*Cecidomyia leguminicola*) and the clover-root borer (*Hylastes trifolii*), whenever they occur within easy reach of the gas-works of our cities, &c.

This recommendation followed Dr. Lintner's previous statement* to the effect that the best remedy he was prepared to offer was "turning deeply under the infested fields while the larvæ are most abundant" or (adopting our suggestion made in the report of the Entomologist, U. S. Dept. Agr. for 1878, p. 251) "cessation from clover culture for a period of time." These radical plans for extermination need not, however, be adopted unless the total destruction of the seed crop has been brought about, or unless the work of the midge is combined with that of the Root-borer (*Hylesinus trifolii*), and both hay and seed crops are destroyed. Where damage by the midge alone is concerned it will be well to give the remedy first mentioned—early cutting—a fair trial.

Colaspis flavida injuring the LeConte Pear.—The LeConte pear is a very popular fruit in parts of the South, and a great deal of capital is invested in its culture, particularly in parts of Georgia, from which State enormous quantities are shipped every year to northern markets. Although, strictly speaking, it is a second-class fruit, its extreme prolificacy and hardiness render it valuable. It has been claimed that it is blight-proof and that insects will not injure it, but both of these assertions are unwarranted, as young trees, up to four or five years of age, frequently blight, and as the present season has developed an insect enemy of some importance.

This insect is the well-known *Colaspis flavida*, commonly known as the "Grape-vine Colaspis." Specimens were forwarded to us, July 23, 1885, by Mr. L. C. Bryan, of Savannah, together with a newspaper account of the method of work and the damage done in Liberty County, Georgia. The injury complained of was simply the work of the adult beetle, and consisted in riddling the young growth and the tender young leaves as they unfolded in May with small holes, as close together "as the holes in a pepper-box." We treated this species in our Third Missouri Report, showing that in the larva state it feeds on the roots of strawberries, and, after issuing as an adult beetle, it feeds at first on strawberry leaves and afterwards flies to the vineyard, where it riddles the leaves of grape. It is also found feeding on clover leaves in July and August near Washington, and may be found throughout the woods on the wild grapevines. The species seems to be single-brooded in Missouri, and is probably so also in Georgia. No other larval food-plant than strawberry has been found, though doubtless such exist.

No satisfactory remedy has been proposed against the insect in the larva or pupa state, but where the adults occur on pear trees in any

* The Insects of the Clover Plant, Fortieth Ann. Rept. N. Y. State Agr. Soc. for 1880, Author's Edition, pp. 11–15.

number the trees should be sprayed, if the fruit is very young, with the Paris-green or London-purple solution. If they occur in injurious numbers later in the year they can be jarred down upon sheets saturated with kerosene.

Great Damage by the Cottonwood Borer.—In our last annual report we devoted a few pages to the Cottonwood Leaf Beetle (*Plagiodera scripta*), which was surprisingly abundant during last season, and incidentally mentioned the Cottonwood Borer (*Saperda calcarata*), with the statement that its injuries had not of late been at all comparable with those of the former insect. During the season of 1885, however, not a single complaint of the Leaf Beetle has been received, while the work of the Borer in parts of Dakota has been very noticeable. Dr. J. V. Lauderdale, post surgeon at Fort Sully, sent us specimens of the larvæ on July 25, with the statement that they were committing "fearful ravages" among the cottonwoods at the post. "Trees of ten and twelve years' growth are dying from the top limbs to the ground."

This borer is a very difficult insect to fight, piercing the trunk of the tree, as it often does, midway up amongst the branches. There is really no remedy save cutting out the pupæ in April or May, or the larvæ earlier. The beetles make their appearance in June. Where a tree is so badly damaged that it has become unsightly, it should be cut down and burned before the beetles issue.

Leptocoris trivittata injuring Apples (Plate I, fig. 5.).—This bug is quite a common species and has been found in a great variety of situations. It is characteristically a plant-feeder, but has never been known to occur in such numbers as to do much damage to any cultivated crop. It has been found in large flowers like magnolia, covered with pollen, and occurs in summer on the stems and leaves of annual plants, which it probably punctures. In August of the present year, however, specimens were sent to us by Mr. A. L. Siler, of Ranch, Kane County, Utah, as injuring fruit at Kanab, the county seat of the same county. Mr. Siler's attention was called to them by the postmaster, Mr. B. L. Young, who stated that these insects were destroying their fruit crop, eating the fruit as fast as it ripened. On one tree which Mr. Siler examined, and which bore apples of a medium size, they were present in enormous numbers, and every apple that he could see was covered with the bugs. They were stated to have bred on the Box Elder shade trees (*Negundo aceroides*).

We wrote Mr. Siler, advising him to have the trees sprayed with a dilute kerosene emulsion by means of a force-pump with a spray-nozzle. The breeding of the bugs on Box Elder, and their desertion of this tree for the ripening fruit, makes the case precisely similar to that of the Red Bug or Cotton Stainer (*Dysdercus suturellus*, to which it is moreover quite closely related) in Florida, as where cotton and oranges are grown near together the bugs desert the cotton, on which they breed, for the more attractive fruit. There the bugs are attracted to piles of cotton-

seed or decaying oranges, on which they cluster in the cool of the morning, and are then readily killed in bulk by drenching them with hot water or pure kerosene.

This offers a suggestion as to the probable efficacy of a similar remedy for the Leptocoris, although as yet no experiments have been tried and no extended observations made as to its habits.

PROCONIA UNDATA IN INJURIOUS NUMBERS. (Plate I, fig. 4.)—August 14, 1885, Dr. A. Oemler, of Wilmington Island, Georgia, wrote us of an insect which was becoming very abundant and injurious to a number of different plants in his vicinity. August 29, in reply to a request, he sent a number of specimens of *Proconia undata*, and among them one specimen of *Analcises mollipes*, included probably on account of its superficial resemblance to the former species. He wrote that he observed them to be more common than usual in 1884, particularly on the young growth of a Black Hamburg grape-vine, and that this year they were plentiful, doing considerable damage to Okra by sucking the sap from its stems, and occurring also upon "mile maize." Writing again, September 6, he stated that one patch of Okra was nearly killed out, and that there were "eight or ten specimens at a time to each plant."

OCCURRENCES OF THE ARMY WORM DURING THE SEASON.—1885 has been a decidedly off year for *Leucania unipuncta*. In no case was the normal second brood injurious to any extent, so far as we can learn. The third brood appeared, however, in injurious numbers at Deer Park, Garrett County, Maryland, damaging the oat crop to a considerable extent on the farm of the ex-United States Senator, H. G. Davis, during the first week in August. Either the same brood retarded, or a fourth generation appeared about September 18 in Sussex County, Delaware. One of our correspondents, Dr. R. G. Ellegood, of Concord, writing under date of September 21, says:

"They made their appearance three days ago in a piece of low cornfield in this county. In one of my professional rides yesterday I came in contact with them. Though but three days in operation they have utterly destroyed 8 or 10 acres of corn. The ground is covered with them and with their excrementitious droppings."

On September 2, Mr. John B. Smith, visiting Goshen, Orange County, New York, for the purpose of studying the Onion Cut-worm (*Agrotis messoria*), found that the Army Worm was quite abundant in the oat fields near that place, so much so as to attract general notice. Returning to the same locality on October 5, he found no traces of larvæ, eggs, or imagines, and only a few pupa shells in the oat fields, but the larvæ could probably have been found in the neighboring grass-lands.

One of our correspondents, Mr. M. S. Crane, of Caldwell, N. J., wrote us October 13, that while sugaring for moths August 26 he counted over forty Army Worm moths on his first seven baits. He has captured the moths every year, but this season they were unusually abundant. No damage from the worms, however, was reported from his vicinity.

California Remedies for the Woolly Aphis.—Mr. W. G. Klee writes in Bulletin No. 55 of the Agricultural Experiment Station of the University of California about the widespread disease of the apple tree produced by the Woolly Aphis (*Schizoneura lanigera*) and its repression. He describes the insect and the astonishing rapidity of its increase in the dry climate of California. After trying the various remedies suggested for its extermination upon the twigs, such as rubbing kerosene on the infested spots, or washing them with lye (three-quarter pounds to the gallon), or with a solution of whale-oil soap, or sulpho-carbonate of potassium, he found them only of use in arresting the disease. If, however, the roots are once thoroughly infested, all the remedies usually recommended proved insufficient or impracticable. Gas lime was found very efficacious, as well as inexpensive. It has to be used with care, and the dose must be regulated according to the character of the soil and subsoil and the age of the trees. In a porous and deep soil there is less danger than in a clayey one, where the water charged with the antidote permeates the soil very slowly, and has time to corrode the bark. It is always safe to use only a small dose first—from one shovelful on a small tree to four on a very large one, spread over the surface, according to the spread of the roots; the rain will wash it into the soil. Fresh ashes should be piled close about the trunk to prevent the aphis from descending to the roots. He found that lady-bugs would consume most of the Aphids adhering to the twigs, and to protect these beneficial insects it is wise to have conifers growing in the vicinity of the orchards to provide hibernating quarters for them. Two to three sprayings of the trees are also recommended; the first application with hot water of 140° F., the second with tobacco water and whale-oil soap in the following proportions: In a decoction of tobacco (1 gallon water to one-half pound tobacco) put half a pound of whale-oil soap. This mixture ought to be applied at about 130° F., and should be followed in about a week by another application.

Seedlings of the Golden Russet and Rawle's Janet are exempt, possessing tough and wiry roots.

The Hessian Fly in California.—A number of notices have occurred in the California newspapers during the season, relative to the appearance of the Hessian Fly on the Pacific Coast. Anxious to learn the truth of these reports, we wrote for confirmation to Mr. Matthew Cooke, of Sacramento, who answered under date of May 29 that he had traveled extensively through the infested section of the State and had seen unmistakable proofs of the presence of the fly. He defines the region as follows:

"Take a map of California; find Vallejo, in Solano County (opposite Mare Island Navy-yard), and draw a line to Benicia (8 miles). From Benicia continue the line to Suisun, and then in a north or northwest direction draw a line that will fall north of Napa City, in Napa County; thence back to Vallejo. This will be a line of nearly 60 miles, and the

grain lands in this section are infested by the Hessian Fly. A section of country in Sonoma County, located between Petaluma and Santa Rosa, is also infested. I have not examined other sections reported. About six years ago it appeared in a field of grain (wheat) near Vallejo, and has spread since that time. Mr. Brownlee, of Creston, about 10 miles from where it first started, lost 380 acres of wheat in 1883."

Specimens which Mr. Cooke sent with his letter proved the correctness of his determination. If the insect has really, as he states, been a denizen of California for six years, it seems strange that the fact should never before have been authoritatively placed on record. We have been on the lookout for such a fact ever since the publication of Dr. Packard's first map of the distribution of the species,* and when Mr. Cooke in his work on injurious insects, in 1883†, stated that he had no knowledge of its existence in California, we accepted his evidence as practically conclusive.

We shall now watch its further spread in the State with interest, more particularly to see whether the energetic Californians will fight this pest any more successfully than the Eastern farmers have done.

It is worthy of note also that the False Chinch Bug (*Nysius destructor*) has done great damage in vineyards in California during the summer, and that it was also reported as injuring rye and wheat.

"Wheel Bugs" destroying Hive Bees.—In October we received from Mr. C. M. Gibbens, of Winchester, Va., a live specimen of the Wheel Bug (*Prionotus cristatus*), with the information that it was found in abundance upon his grounds and preyed upon his honey bees, lurking about their hives. Although the Wheel Bug is, so far as we know, exclusively a predaceous insect, this particular habit has not, we think, before been observed.

Agonoderus pallipes injurious to Corn (Plate I, fig. 2).—This common ground beetle was, until quite recently, supposed to be strictly carnivorous. In 1882, Professor Forbes, in the Twelfth Report of the State Entomologist of Illinois, page 27, recorded that he found this species (referring to it as *A. comma*) under the clods and in the ground about the roots of corn in a field, which was injured by the Corn-root Worm (*Diabrotica longicornis*), and on examination of the stomach contents they were found to have partaken both of animal and vegetable food. In the same report (p. 43) he states that he found them in a field of corn infested by the Chinch Bug, and examination showed that they had fed in part on Chinch Bugs and other insects, but also on vegetation, which appeared to have been roots of corn. On page 111 (*loc. cit.*) he states that a dissection of the stomachs of fifteen specimens of this

* Report upon the Rocky Mountain locust and other insects, &c. Ninth Ann. Rept. U. S. Geol. and Geogr. Surv. Terr., Washington, 1877.

† "Injurious insects of the orchard, vineyard," &c. By Matthew Cooke, Sacramento, 1883.

species showed the presence of 50 per cent. of vegetable material, all fragments of the higher plants except 2 per cent. of common fungi.

During the last summer specimens of this beetle were received from Illinois (H. H. Harris, Lynnville, Morgan County) and Iowa (J. M. Evans, Salem, Henry County, through Dr. J. M. Shaffer, of Keokuk), with the information that it was damaging young corn by gnawing into the seed grain and by eating the sprouting roots. The exact amount of damage done was not stated, but it was said to be quite extensive. Specimens were sent to the Department showing the beetle actually engaged in eating a large cavity into the seed, as shown in the figure, so that there can be no doubt as to the accuracy of the observation.

If this damage should become extensive, a satisfactory remedy will be found in soaking all seed-corn for a short time before planting in some arsenical solution, such as Paris green or London purple, in water. Such a course will not injure the germinative quality of the seed, and will probably result in the death of all beetles which attempt to gnaw the seed.

EXPLANATION TO PLATE.

FIG. 1.—*Ligyrus rugiceps*—natural size (after Comstock).
FIG. 2.—*Agonoderus pallipes*—enlarged (original).
FIG. 3.—*Gelechia obliquistrigella*—enlarged (original).
FIG. 4.—*Proconia undata*—enlarged (original).
FIG. 5.—*Leptocoris trivittata*—enlarged (original).
FIG. 6.—*Monephora bicincta*—enlarged (original).

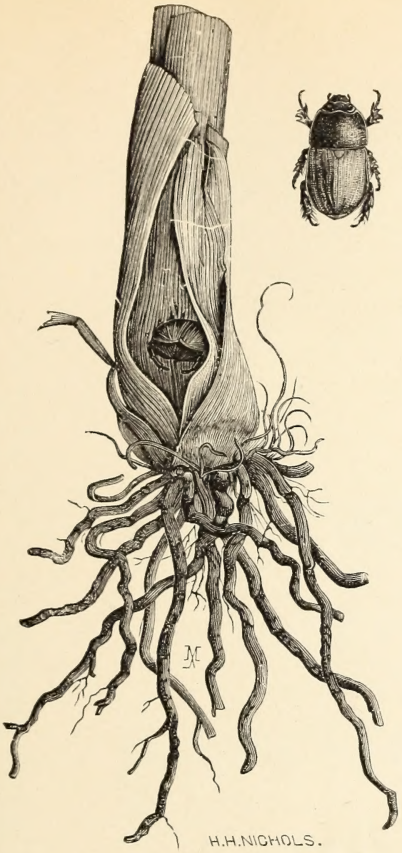

Fig. 1.

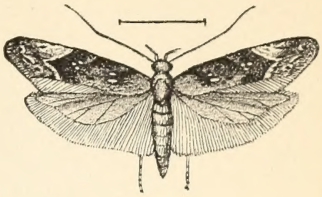

Fig. 3.

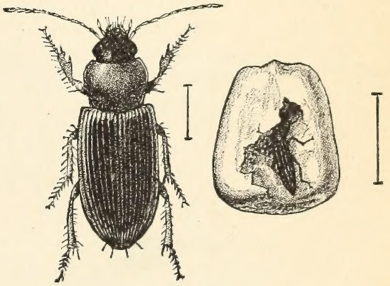

Fig. 2.

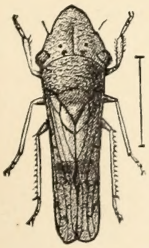

Fig. 4.

Fig. 5.

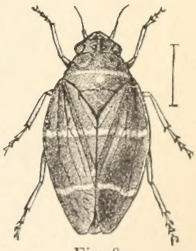

Fig. 6.